COMPRESSOR

BACKGROUND OF THE INVENTION

Field of the Invention

[01] The present invention relates to a compressor, and more particularly, to a compressor that can effectively reduce a refrigerant gas pulsation pressure upon discharge of a refrigerant gas.

Background of the Related Art

[02] A compressor, which is adapted for being used in an air conditioning system of an automobile, selectively receives the power of an engine transmitted from a pulley by the intermittent action of an electromagnetic clutch, sucks a refrigerant gas coming from an evaporator thereinto, and compresses the refrigerant gas to discharge the compressed refrigerant gas to a condenser. The compressor is different in the types in accordance with the compression construction, and the type widely utilized in the automobiles is a swash plate type of compressor.

[03] FIGS. 1 to 4 show the structure of a general swash plate type of compressor.

[04] As shown in FIGS. 1 and 2, the general swash plate type of compressor is constructed in such manners that a swash

plate 40 onto which a drive shaft 30 is mounted is assembled with a pair of cylinder blocks 10 and 20, respectively, and a plurality of pistons 50 are disposed on the outer face of the swash plate 40 in such a manner as to be housed in a plurality of cylinder bores formed on the cylinder blocks 10 and 20. Each piston 50 linearly reciprocates in the corresponding cylinder bore with the help of piston shoes 60 as the swash plate 40 is rotated, thereby sucking and compressing the refrigerant gas. In this manner, a valve unit 70 that is provided with a suction valve 71, a valve plate 72 and a discharge valve 73, and a gasket are assembled with the outsides of the cylinder blocks 10 and 20, respectively, in the aforementioned order, and a front housing 80 is coupled with the cylinder block 10 and a rear housing 90 is coupled with the cylinder block 20, for housing and protecting the components as mentioned above therein.

[05] Under the above structure, the general swash plate type of compressor rotates the swash plate 40 when power is applied from a pulley of an electromagnetic clutch 31, and whenever the swash plate 40 is rotated at a time, the plurality of pistons 50 that are disposed at the outer face of the swash plate 40 start to carry out the reciprocating motion, thereby completing one stroke time. Thereby, some of the plurality of pistons 50 are moved toward the front housing 80 and at the same time, the others thereof are moved toward the rear housing 90 by

means of the swash plate 40, such that the refrigerant gas that flows into the front and rear housings 80 and 90 through a manifold 96 having a suction muffler 94 and a discharge muffler 95 is delivered to compression chambers 81 and 91 that are defined at the inner side walls of the front and rear housings 80 and 90. The refrigerant gas compressed herein is carried into the rear housing 90 through a prescribed passageway and mixed with the compressed refrigerant gas discharged from the rear housing 90, thereby being discharged toward the outside of the compressor.

[06] An explanation of the construction of the passageway for discharging the compressed refrigerant gas toward the outside and the operation of the components will be in more detail given. As shown in FIGS. 2 to 4, the compression chamber 81 in which the compressed refrigerant gas is stored is defined at the central portion in the inner face of the front housing 80, and the pair of cylinder blocks 10 and 20 are provided with guide holes 11 and 21 that are disposed at predetermined positions thereon to correspond with each other, with a result that they serve to guide the refrigerant gas in the compression chamber 81 to the compression chamber 91 defined in the rear housing 90. In the same manner as the front housing 80, the rear housing 90 is provided with the compression chamber 91 that is disposed at the central portion in the inner face thereof and with a discharge

passageway 92 that is extended curvedly along the outer peripheral wall of the compression chamber 91 for connection with a discharge chamber 93, for guiding the compressed refrigerant gas to the outside through a hole H.

[07] Thereby, when the swash plate 40 is rotated at a high speed, the plurality of pistons 50 reciprocate such that the refrigerant gas is compressed in the compression chambers 81 and 91 of the front and rear housings 80 and 90, respectively. Then, the refrigerant gas compressed in the compression chamber 81 of the front housing 80 is delivered to the discharge chamber 93 of the rear housing 90 through the guide holes 11 and 21 on the cylinder blocks 10 and 20, and the refrigerant gas compressed in the compression chamber 91 of the rear housing 90 is also delivered to the discharge chamber 93 through the discharge passageway 92, such that they are mixed in the discharge chamber 93 and discharged to the outside through an outlet port 94.

[08] In the general swash plate type of compressor, however, since the discharge passageway 92 that is adapted to discharge the compressed refrigerant gas in the rear housing 90 to the outside is separately defined in a generally semicircular shape at one side of the compression chamber 91, the upper opening at the other side of the compression chamber 91 must be closed by anti-leaking means such as a gasket. Further, there is a need for installation of separate parts for sealing the discharge

passageway, which requires complexity in construction of the compressor.

[09] In addition, the narrow and long semicircular structure of the discharge passageway 92 become an obstacle in refrigerant gas flow, and eventually creates pressure loss. A high pressure refrigerant gas collides against the inner peripheral wall of the discharge passageway 92, which undesirably causes the generation of noise due to the refrigerant gas pulsation.

[10] Since the discharge passageway 92 occupies a certain area of the suction chamber so as to reduce the volume of the suction chamber, it covers partially the suction ports 72a which are placed above the discharge passageway 92 among the suction ports of the valve plate 72, and accordingly, the suction operation of the refrigerant gas is subject to a large resistance.

[11] Moreover, the formation of the separate discharge passageway 92 makes the construction of the compressor more complicated, and where any design modifications on the structure of the compression chamber 91 of the rear housing 90 occurs to improve it, the peripheral parts such as a gasket relating to the discharge passageway 92 must also be changed. Undesirably, this increases the number of processes for this and causes the production costs to be substantially high. Also, as the suction and discharge of the refrigerant gas are not smooth, the

refrigerant gas discharge pressure is reduced and a noise due to the refrigerant gas pulsation occurs.

[12] To solve these problems, there is disclosed in U.S. Patent No. 6,068,453 filed by the present assignee that suggests a swash plate type compressor provided with a discharge passageway disposed on a rear housing, thereby improving the refrigerant gas discharge structure.

[13] FIG. 5 is a front view of a rear housing of a compressor in the prior art.

[14] As shown, a rear housing 100 is provided with a many-sided inner wall 101 projecting upwardly from the inside bottom surface thereof, an extended portion 102 formed extending from the inner wall 101 at a portion thereof, suction and discharge chambers 103 and 104 isolated from each other by the inner wall 101 and the inner peripheral wall of the rear housing 100, and a discharge conduit 106 for delivering the compressed refrigerant gas discharged into the discharge chamber 104 toward the outside of the compressor, the discharge conduit 106 extending by a certain length in the discharge chamber 104 at one end thereof and communicating with an outlet chamber 105 at the other end thereof.

[15] The discharge conduit 106 of the rear housing 100 extends to about half of the straight distance L between a point B on an interior surface of the inner wall 101 and a point A

connecting the extended portion 102, with reference to the center line of the discharge conduit 106.

[16] According to the aforementioned structure where the discharge conduit 106 is provided inside the rear housing 100, the compressed refrigerant gas in the front housing and the compressed refrigerant gas in the rear housing are mixed in the outlet chamber 105 via the discharge conduit 106 so as to cancel two refrigerant gas pulsation waves with each other and then discharged into the outside of the compressor.

[17] In this prior art, however, since the refrigerant gas pulsation pressure when the refrigerant gas is discharged from the front housing toward the outside of the compressor is not effectively reduced, there is a limitation in the reduction of the refrigerant gas pulsation pressure as a whole, and moreover, where a large discharge muffler having a manifold disposed outside the compressor is provided to solve the problem, there occurs another problem that a volume of the compressor must be eventually increased.

SUMMARY OF THE INVENTION

[18] Accordingly, the present invention is directed to a compressor that substantially obviates one or more problems due to limitations and disadvantages of the related art.

[19] An object of the present invention is to provide a compressor that can effectively reduce a refrigerant gas pulsation pressure upon discharge of a refrigerant gas.

[20] Additional advantages, objects, and features of the invention will be set forth in part in the description which follows and in part will become apparent to those having ordinary skill in the art upon examination of the following or may be learned from practice of the invention. The objectives and other advantages of the invention may be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

[21] In accordance with the present invention, there is provided a compressor comprising: a front housing closing one end of a front cylinder block; a rear housing closing one end of a rear cylinder block; the front and rear cylinder blocks being arranged to be combined with each other between the front and rear housings; refrigerant gas inlet and outlet ports formed on the outer peripheral surface of at least any of the front and rear cylinder blocks; a front discharge conduit provided to pass through a first partition defining a front refrigerant gas discharge chamber to be isolated from a front refrigerant gas suction chamber, inside the front refrigerant gas suction chamber, thereby delivering the refrigerant gas discharged into the front refrigerant gas discharge chamber of the front housing toward the

outside of the compressor; a rear discharge conduit provided to pass through a second partition defining a rear refrigerant gas discharge chamber to be isolated from a rear refrigerant gas suction chamber, inside the rear refrigerant gas suction chamber, thereby delivering the refrigerant gas discharged into the rear refrigerant gas discharge chamber of the rear housing toward the outside of the compressor; front and rear auxiliary expansion portion formed communicating with the outlet sides of the front and rear discharge conduits; discharge coupling passageways disposed in the front and rear cylinder blocks and connected with the front and rear auxiliary expansion portion; and a main expansion portion provided between the discharge coupling passageways in such a manner as to communicate with the refrigerant gas outlet port.

[22] According to the present invention, preferably, the main expansion portion is formed extending an end of the discharge coupling passageway of the front cylinder block or the rear cylinder block, as an integral body in the front or rear cylinder block.

[23] According to the present invention, preferably, the main expansion portion is separately formed outside the front cylinder block or the rear cylinder block.

[24] According to the present invention, preferably, at least one or more the front and rear discharge conduits are

positioned at shortest distances between the central portions of the front and rear refrigerant gas discharge chambers of the front and rear housings and the central portions of the inlet ends thereof.

[25] According to the present invention, preferably, at least one or more the front and rear auxiliary expansion portion have volumes larger than volumes of the front and rear discharge conduits.

[26] According to the present invention, preferably, at least one or more the discharge coupling passageways have passageway sectional areas larger than or the same as passageway sectional areas of the front and rear discharge conduits.

[27] According to the present invention, preferably, the main expansion portion has a volume larger than or the same as a sum of volumes of the front and rear auxiliary expansion portion.

[28] According to the present invention, preferably, at least one or more the front and rear discharge conduits communicate with the lower face of any of the front and rear auxiliary expansion portion.

[29] According to the present invention, preferably, at least one or more the front and rear discharge conduits have passageway sectional areas that become increased toward the outlets from the inlets thereof or become increased step by step.

[30] According to the present invention, preferably, a passageway length between the front discharge conduit of the front housing and the refrigerant gas outlet port is the same as a passageway length between the rear discharge conduit of the rear housing and the refrigerant gas outlet port.

[31] It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[32] The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this application, illustrate embodiment(s) of the invention and together with the description serve to explain the principle of the invention. In the drawings:

[33] FIG.1 is an exploded perspective view of a general compressor;

[34] FIG. 2 is a front sectional view of the compressor of FIG. 1;

[35] FIG. 3 is a front view of a front housing of the compressor of FIG. 1;

[36] FIG. 4 is a front view of a rear housing of the compressor of FIG. 1;

[37] FIG. 5 is a front view of a rear housing of a compressor in the prior art;

[38] FIG. 6 is a side view of a compressor according to a first embodiment of the present invention;

[39] FIG. 7 is a side sectional view of the compressor of FIG. 6;

[40] FIG. 8 is a front view of a front housing employed in the compressor of FIG. 6;

[41] FIG. 9 is a front view of a rear housing employed in the compressor of FIG. 6; and

[42] FIG. 10 is a side sectional view of a compressor according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[43] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

[44] FIG. 6 is a side view of a compressor according to a first embodiment of the present invention, FIG. 7 is a side sectional view of the compressor of FIG. 6, FIG. 8 is a front view of a front housing employed in the compressor of FIG. 6, and

FIG. 9 is a front view of a rear housing employed in the compressor of FIG. 6.

[45] In a first embodiment of the present invention, as shown in FIGS. 6 and 7, the compressor comprises: a front housing 200 closing one end of a front cylinder block 400; a rear housing 300 closing one end of a rear cylinder block 500; the front and rear cylinder blocks 400 and 500 being arranged to be combined with each other between the front and rear housings 200 and 300; a drive shaft 600 rotatably supported in the central portions of the front and rear cylinder blocks 400 and 500; a swash plate 700 disposed on the drive shaft 600; and a plurality of pistons 900 operatively coupled with the outer peripheral surface of the swash plate 700 via piston shoes 800. Hereinafter, an explanation on the construction that is similar to or the same as that in the conventional practice will be avoided for the brevity of the description.

[46] As shown in FIGS. 7 and 8, the front housing 200 is opened on the rear portion thereof, and it is provided with a front refrigerant gas suction chamber 210 for supplying a refrigerant gas flowing into the compressor to cylinder bores (not shown) on the front cylinder block 400 (see FIG. 7) and with a front refrigerant gas discharge chamber 220 for discharging the compressed refrigerant gas flowing from the cylinder bores toward the outside of the compressor, at the inner peripheral wall

thereof (that is, at the inner face of the front wall thereof). The front refrigerant gas suction chamber 210 is isolated from the front refrigerant gas discharge chamber 220, by means of a partition 230 that is formed in a shape of a generally closed curve, at the outer face of the front refrigerant gas discharge chamber 220. In front of the front wall face of the front housing 200 from a central portion of the front refrigerant gas discharge chamber 220, there are provided a pulley (not shown) that is rotatably mounted via bearings (not shown) and a nose portion 202 (see FIG. 8) through which the drive shaft 600 is passed is projected rotatably supporting the drive shaft 600.

[47] As shown in FIGS. 7 and 9, further, the rear housing 300 is opened on the front portion thereof and assembled with the rear cylinder block 500. The rear housing 300 is provided with a rear refrigerant gas suction chamber 310 for supplying a refrigerant gas flowing into the compressor to cylinder bores (not shown) on the rear cylinder block 500 (see FIG. 7) and with a rear refrigerant gas discharge chamber 320 for discharging the compressed refrigerant gas flowing from the cylinder bores toward the outside of the compressor, at the inner peripheral wall thereof (that is, at the inner face of the rear wall thereof). The rear refrigerant gas suction chamber 310 is isolated from the rear refrigerant gas discharge chamber 320, by means of a partition 330 that is formed in a shape of a generally closed

curve, at the outer face of the rear refrigerant gas discharge chamber 320.

[48] As shown in FIG. 7, the front cylinder block 400 is provided with a discharge coupling passageway 410, and the rear cylinder block 500 with a discharge coupling passageway 510, the discharge coupling passageways 410 and 510 communicating with each other such that the refrigerant gas discharged from the front and rear housings 200 and 300 is discharged toward the refrigerant gas outlet port 530. The discharge coupling passageway 410 is connected to front auxiliary expansion portion 250 of the front housing 200, and the discharge coupling passageway 510 to rear auxiliary expansion portion 350 of the rear housing 300. The discharge coupling passageways 410 and 510 are extended at end portions thereof to thereby form the main expansion portion 420 in the front and rear cylinder blocks, as an integral body therewith.

[49] In the preferred embodiment of the present invention, the refrigerant gas inlet port 520 and the refrigerant gas outlet port 530 are positioned on the outer peripheral surface of the rear cylinder block 500, but may be positioned on the outer peripheral surface of the front cylinder block 400. Otherwise, if one of them is disposed on the outer peripheral surface of the front cylinder block 400, the other may be disposed on the outer peripheral surface of the rear cylinder block 500.

[50] Referring to the passageways through which the refrigerant gas is sucked, compressed and discharged in the compressor under the construction as mentioned above, as shown in FIG. 7, when the drive shaft 600 is rotated by the transmission of power from a power source, the swash plate 700 is also rotated together such that the plurality of pistons 900 are reciprocated in the respective cylinder bores of the front and rear cylinder blocks 400 and 500 in accordance with the phases of the swash plate 700. During the reciprocating motion of the plurality of pistons 900, a vacuum pressure is formed in the cylinder bores such that the refrigerant gas flows into a swash plate chamber S via the refrigerant gas inlet port 520 that is connected with an evaporator (which is omitted in the drawing).

[51] The refrigerant gas that is introduced into the swash plate chamber S is sucked into the cylinder bores of the front and rear cylinder blocks 400 and 500, respectively.

[52] As the refrigerant gas sucked into the cylinder bores is compressed with the compression stroke of the pistons 900, it is discharged toward the front and rear refrigerant gas discharge chambers 220 and 320 of the front and rear housings 200 and 300 through an opening formed in the valve plate that is opened by means of a discharge reed valve and through an opening on a suction reed valve.

[53] Referring to the passageways through which the refrigerant gas flowing into the front and rear refrigerant gas discharge chambers 220 and 320 of the front and rear housings 200 and 300 is discharged toward the outside of the compressor, the refrigerant gas discharged from the front and rear housings 200 and 300, respectively, is carried via the discharge coupling passageways 410 and 510 of the front and rear cylinder blocks 400 and 500 into the refrigerant gas discharge port 530 through which the refrigerant gas is discharged toward the outside of the compressor.

[54] In this manner, as shown in FIGS. 6 and 7, the front and rear housings 200 and 300 are provided with the front and rear discharge conduits 240 and 340 that are formed extending from the front and rear refrigerant gas discharge chambers 220 and 320 to pass through the partitions 230 and 330, the front and rear discharge conduits 240 and 340 being provided with the auxiliary expansion portion 250 and 350 at the outlets thereof.

[55] Thus, the refrigerant gas in the rear refrigerant gas discharge chamber 320 is carried into the discharge coupling passageway 510 of the rear cylinder block 500 via the rear discharge conduit 340 and the auxiliary expansion portion 350, and the refrigerant gas in the front refrigerant gas discharge chamber 220 is carried into the discharge coupling passageway 410 of the front cylinder block 400 via the front discharge conduit

240 and the auxiliary expansion portion 250 and then passed through the main expansion portion 420 together with the refrigerant gas delivered from the discharge coupling passageway 510 of the rear cylinder block 500. After that, the refrigerant gas is discharged through the refrigerant gas discharge port 530 toward the outside of the compressor.

[56] In the case wherein the front and rear discharge conduits 240 and 340 discharging the refrigerant gas from the front and rear refrigerant gas discharge chambers 220 and 320 toward the auxiliary expansion portion 250 and 350 communicate with the upper faces of the partitions 230 and 330, the refrigerant gas may stay at the lower ends of the auxiliary expansion portion 250 and 350 at the time when it is moved toward the discharge coupling passageways 410 and 510, thereby making it difficult to reduce the refrigerant gas pulsation pressure. In the preferred embodiment of the present invention, preferably, at least one or more the front and rear discharge conduits 240 and 340 of the front and rear housings 200 and 300 communicate with the lower faces of the auxiliary expansion portion 250 and 350 so as to prevent the refrigerant gas from staying in the auxiliary expansion portion.

[57] In the preferred embodiment of the present invention, furthermore, the passageway length between the front discharge conduit 240 of the front housing 200 and the refrigerant gas

discharge port 530 is the same as the passageway length between the rear discharge conduit 340 of the rear housing 300 and the refrigerant gas discharge port 530, with a result that the differences between the refrigerant gas pulsation pressures discharged from the front and rear housings 200 and 300 are substantially identical with one another, thereby decreasing the refrigerant gas pulsation pressure.

[58] In the preferred embodiment of the present invention, moreover, so as to effectively reduce the pulsation pressure occurring when the refrigerant gas is discharged from the front and rear housings 200 and 300 toward the outside of the compressor, the volumes of the auxiliary expansion portion 250 and 350 are preferably larger than volumes of the front and rear discharge conduits 240 and 340. That is to say, the refrigerant gas delivered from the front and rear refrigerant gas discharge chambers 220 and 320 flows into the large volumes of auxiliary expansion portion 250 and 350 through the small volumes of front and rear discharge conduits 240 and 340, which enables the refrigerant gas pulsation pressure to be reduced. In the preferred embodiment of the present invention, also, at least one or more the front and rear discharge conduits 240 and 340 have passageway sectional areas that become increased toward the outlets from the inlets thereof or become increased step by step, and at least one or more the front and rear discharge conduits

240 and 340 are positioned at shortest distances L1 and L2 between the central portions of the front and rear refrigerant gas discharge chambers 220 and 320 of the front and rear housings 200 and 300 and the central portions of the inlet ends thereof.

[59] Also, if the passageway sectional areas of the front and rear discharge conduits 240 and 340 are larger than the passageway sectional areas of the discharge coupling passageways 410 and 510, the amount of the refrigerant gas flowing into the front and rear auxiliary expansion portion 250 and 350 becomes larger than that flowing therefrom such that the refrigerant gas stays in the front and rear auxiliary expansion portion 250 and 350. Desirably, therefore, the passageway sectional areas of the discharge coupling passageways 410 and 510 are larger than or the same as the passageway sectional areas of the front and rear discharge conduits 240 and 340.

[60] As discussed above, especially, the main expansion portion 420 has a volume larger than or the same as a sum of volumes of the front and rear auxiliary expansion portion 250 and 350 so as to prevent the refrigerant gas from staying in the front and rear auxiliary expansion portion 250 and 350.

[61] Since the sectional areas of the discharge coupling passageways 410 and 510 and the main expansion portion 420 differ from each other, a muffler effect occurs during the transfer of the refrigerant gas to the discharge coupling passageways 410 and

510 and the main expansion portion 420, thereby enabling the refrigerant gas pulsation pressure to be substantially reduced.

[62] In the preferred embodiment of the present invention, the refrigerant gas pulsation pressure is reduced in multi-step when the refrigerant gas is discharged into the rear refrigerant gas discharge chamber 320 toward the outside of the compressor and into the front refrigerant gas discharge chamber 220 toward the outside of the compressor, thereby obtaining excellent reduction in the refrigerant gas pulsation pressure.

[63] FIG. 10 is a side sectional view of a compressor according to a second embodiment of the present invention.

[64] In the second embodiment of the present invention, as shown in FIG. 10, the construction and action of the compressor are the same as those in the first embodiment of the present invention, except that the main expansion portion 410 is connected to the front and rear discharge coupling passageways 410 and 510 in the front and rear cylinder blocks 400 and 500, separately formed on the outer peripheral surface of the front cylinder block 400 or the rear cylinder block 500.

[65] In this manner, since the pulsation pressure of the discharged refrigerant gas is reduced through the discharge conduits 240 and 340 and the front and rear auxiliary expansion portion 250 and 350, a size of the main expansion portion 420 is substantially smaller than that of a conventional manifold or a

discharge muffler, thereby enabling the package of the compressor to be reduced.

[66] While the preferred embodiments of the present invention are applied to the construction of the compressor where the front and rear housings 200 and 300 are combined with one another in such a manner where the ends of the front and rear cylinder blocks 400 and 500 are closed by the front and rear housings 200 and 300, they can be applied in the same manner as that of the compressor where the front and rear cylinder blocks 400 and 500 are disposed and assembled inside the front and rear housings 200 and 300.

[67] As clearly described above, a compressor according to the preferred embodiments of the present invention can reduce the refrigerant gas pulsation pressure in multi-step when a refrigerant gas is discharged into the rear refrigerant gas discharge chamber toward the outside of the compressor and into the front refrigerant gas discharge chamber toward the outside of the compressor, thereby obtaining excellent reduction in the refrigerant gas pulsation pressure and remarkably reducing a noise due to the refrigerant gas pulsation.

[68] Thus, there is no need for formation of a separate expanding space portion having a substantially large passageway sectional area at the outside of the compressor, and even though the separate expanding space portion is provided at the outside

of the compressor, the compressor of this invention can be compact in the size of the package.

[69] The foregoing embodiments are merely exemplary and are not to be construed as limiting the present invention. The present teachings can be readily applied to other types of apparatuses. The description of the present invention is intended to be illustrative, and not to limit the scope of the claims. Many alternatives, modifications, and variations will be apparent to those skilled in the art.